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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/053,446	01/17/2002	Janis Virbulis	VIRBULIS ET AL -I	3544

7590 04/01/2003

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EXAMINER

SONG, MATTHEW J

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 04/01/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/053,446	VIRBULIS ET AL.	
	Examiner	Art Unit	
	Matthew J Song	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 March 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-13 is/are pending in the application.
- 4a) Of the above claim(s) 5-13 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>6, 6 1/2</u> . | 6) <input type="checkbox"/> Other: |

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of Group I, claims 1-4 in Paper No. 8 is acknowledged.

The traversal is on the ground(s) that the search of claims 1-4 would necessarily include a search for claims 5-13 and the claimed apparatus can be used only for the claimed process is not found persuasive because a serious burden exists in the differing issues likely to arise during the prosecution of the different statutory classes of the invention. Furthermore, claims 1-4 are classified in class 117, subclass 13 and claims 5-13 are classified in class 117, subclass 200 and the different classification of the two inventions would require separate searches. Also, the claimed apparatus can be used in another and materially different process, such as one where a crystal other than silicon is produced.

The requirement is still deemed proper and is therefore made FINAL.

2. Claims 5-14 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected invention, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in Paper No. 8.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

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4. Claims 1-2 are rejected under 35 U.S.C. 102(b) as being anticipated by Iida et al (US 6,077,343).

Iida et al discloses a Czochraski method of producing a silicon single crystal comprising a annular solid-liquid interface insulator 8 and upper surrounding insulator disposed above a silicon melt (col 10, ln 15-60 and Fig 3), this reads on applicant's heat shield, and a vertical magnetic field is applied to a silicon melt 2 to suppress convection in the melt, this reads on applicant's vertically orientated force on the melt in a region of the crucible wall (col 10, ln 61 to col 11, ln 10 and col 8, ln 50-65). Iida et al also teaches a producing a 6 inch single crystal ingot from a crucible having a diameter of 18 inches (457.2 mm) (Example 1) and a oxygen concentration of 14 ppma (col 14, ln 15-25). Iida et al also teaches a crystal having a larger diameter, such as 8 to 16 inches (203.2mm to 406.4mm) can be formed (col 14, ln 30-40). Iida et al also discloses an oxygen concentration of 14 ppma (col 14, ln 1-35).

Referring to claim 2, Iida et al discloses an oxygen concentration of 14 ppma, which is greater than 5×10^{17} atoms per cm^3 , note Wilson et al for the conversion of ppma to atoms per cm^3 , below.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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6. Claims 1-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tamatsuka et al (US 6,139,625) in view of Luter et al (US 6,053,974) along with Szekely et al (US 5,196,085).

Tamatsuka et al discloses 8 inch diameter (203.2 mm) silicon single crystal ingots were pulled by the Czochralski method with an oxygen concentration of 0.7×10^{18} atoms/cm³ or more (Table 1) from a silicon melt in a quartz crucible with a diameter of 18 inches (457.2 mm) (col 8, ln 1 to col 9, ln 65).

Tamatsuka et al does not disclose a heat shield above the crucible.

In a method of forming a single crystal by the Czochralski method, note entire reference, Luter et al teaches a heat shield 40 mounted above the surface of a molten source material for growing ingots with a diameter of about 220 mm (Fig 1, col 4, ln 1-67 and col 5, ln 1-15). Luter et al also teaches the overall gradient at the surface is reduced which reduces the number of defects at the surface and the distribution of defects is more even throughout the ingot for ingots produced with the heat shield (col 7, ln 1-15). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Tamatsuka et al with Luter et al's heat shield to reduce defects in the ingot.

Tamatsuka et al is also silent to exposing the silicon melt to an influence of a traveling magnetic field which exerts a substantially vertically orientated force on the melt in a region of the crucible wall.

In a method of controlling the flow in Czochralski (CZ) systems, note entire reference, Szekely et al teaches a CZ growing system with an axial magnetic field in the vicinity of the melt-crystal interface and melt stirring can be accomplished magnetically by inducing vertical motion with a traveling field. Szekely et al also teaches controlling the glow in the bulk and in

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the vicinity of the wells (col 2, ln 1-60). Szekely et al also teaches the magnetic field with an axial upward or downward direction applied selectively at the growing crystal surface vicinity in combination with a moving magnetic field (col 3, ln 10-62). Szekely et al also teaches vertical magnetic fields are useful for stabilizing flow (col 1, ln 5-62). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Tamatsuka et al with Szekely et al's vertical magnetic field because flow instabilities are eliminated (col 1, ln 65-68).

Referring to claim 1, the combination of Tamatsuka et al, Luter et al and Szekely et al teach pulling a silicon ingot with a diameter of 8 inches from a 18 inch crucible, a heat shield for reducing defects and vertical magnetic field to eliminate flow instabilities.

Referring to claim 2, the combination of Tamatsuka et al, Luter et al and Szekely et al teach oxygen concentrations of 0.7×10^{18} atoms/cm³ or more

Referring to claim 3-4, the combination of Tamatsuka et al, Luter et al and Szekely et al teaches the magnetic field with an axial upward or downward direction applied selectively at the growing crystal surface vicinity.

7. Claims 3-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iida et al (US 6,077,343) as applied to claims 1-2 above, and further in view of Kawanishi et al (US 6,086,671).

Iida et al discloses all of the limitations of claim 4, as discussed previously, except Iida et al is silent to the magnetic field is directed upward at the crucible wall.

In a method of growing a single crystal by the Czochralski method, note entire reference, Kawanishi et al teaches a static magnetic field is applied during a pulling of a single crystal and

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the flow of a melt is suppressed (col 2, ln 1-67). Kawanishi et al also teaches an upwardly directed vertical magnetic field to suppress flow towards the crucible walls at a lower region (Fig 5 and col 3, ln 1-65). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Iida et al with Kawanishi et al's upward vertical field to suppress the flow of the melt and control heat convection in the melt (col 3, ln 35-50 and col 2, ln 60-67).

Referring to claim 3, the combination of Iida et al and Kawanishi et al does not teach a downward directed vertical magnetic field. The combination of Iida et al and Kawanishi et al teach the direction of the vertical field is a result effective variable ('671 Fig 5); therefore it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Iida et al and Kawanaishi et al use a downwardly directed field to obtain flow suppression in a desired direction.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Wilson et al (US 6,284,384) teaches 5×10^{17} atoms per cm^3 is equivalent to 10 oxygen atoms per million total atoms in the wafer (col 8, ln 64 to col 9, ln 15).

Nanaka (JP 62-070286) teaches a magnetic field directed downward (Fig 1) and a magnetic field directed upward (Fig 4), note abstract.


9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin L Utech can be reached on 703-308-3868. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song
Examiner
Art Unit 1765

MJS
March 27, 2003


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